METHOD, SYSTEM, AND PRODUCT SERVICE FOR LOCATING ITEMS SATISFYING A GENERAL REQUIREMENT AND RANKING ITEMS ACCORDING TO UTILITY

BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates generally to a method, system, and product for ranking available items according to the utility of each type of item. Still more particularly, the present invention relates to a method, system, and product in a computer system for a service which locates items which satisfy a general requirement and ranks those items according to the utility of each type of item.

2. Description of Related Art:

Intelligent shopping agents are known in the art. These agents typically execute on a client computer system and are used to search a server computer system or other client computer systems for a particular, specified item which may be either goods or services. A user first specifies a particular type of item. A user may specify, for example, a dishwasher. The intelligent agent then searches for and returns a list of available items which match the specified type of item. Therefore, a list of available dishwashers may be returned by the intelligent agent. The user may then select one or more of these available items.

Often times, multiple different items may satisfy a particular user's needs. For example, a user may need to purchase a car. There are many different types of cars which could be purchased to satisfy this requirement. A user may place a higher value, or utility, on one attribute over another. For example, one user may place a higher value on

an intangible attribute, such as status, over the price of a car. The intelligent shopping agent has no way to locate items based on a user's desires. The intelligent shopping agent merely searches for specified items.

As a further example of the limitations of known shopping agents, consider a user who requires transportation but does not require any particular type of transportation means. The user's requirement could be satisfied by buying a bicycle, a motorcycle, a car, or a helicopter. A known intelligent agent could be used to search first for bicycles returning a listing of bicycles. Then, the agent could be used to search for motorcycles, returning a listing of motorcycles. The agent could then be used to search for cars returning a listing of cars. And, the agent could be used to search for helicopters.

The user must then compare the separate listings returned for each type of transportation means in order to select a particular item. Each user will make a selection based on that user's preferences. Each user will place different values on the various attributes of each transportation means in order to make a selection. For example, one user may value ease-of-use and maintenance over status and thus place a greater value on a bicycle over the helicopter. Therefore, a high quality bicycle would be ranked higher than a helicopter. A different user might value status over everything but have limited funds to make a purchase. For this user, cars perceived to have a higher associated status might be ranked first.

Therefore, a need exists for a system, method, and product in a computer system for a service which searches for items which would satisfy a general requirement and which ranks these items according to the utility of each type of item.

SUMMARY OF THE INVENTION

A method, system, and product are described for locating items which satisfy a general requirement and then ranking those items according to the utility of each type of item. A general requirement is first received. A utility is specified for each of multiple types of items which would satisfy the general requirement. Available items are then located which match one of the specified types of items. The located available items are then ranked utilizing the utility specified for the types of items.

The above as well as additional objectives, features, and advantages of the present invention will become apparent in the following detailed written description.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 depicts a block diagram of a data processing system in which the present invention may be implemented;

Figure 2 illustrates a block diagram of a computer system which may be utilized as a server computer system in accordance with the present invention;

Figure 3 depicts a block diagram of a computer system which may be utilized as a client computer system in accordance with the present invention; and

Figure 4 is a high level flow chart which depicts a specification of a requirement and a utility for different types of items in accordance with the present invention; and

Figure 5 is a high level flow chart which illustrates an intelligent software agent searching for and locating available items which match a specified type of items and ranking the located items according to the items' utility in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention and its advantages are better understood by referring to the figures, like numerals being used for like and corresponding parts of the accompanying figures.

The invention is preferably realized using a well-known computing platform, such as an IBM RS/6000 server running the IBM AIX operating system. However, it may be realized in other popular computer system platforms, such as an IBM personal computer running the Microsoft Windows operating system or a Sun Microsystems workstation running operating systems such as UNIX or LINUX, without departing from the spirit and scope of the invention.

The present invention is a method, system, and product within a computer system for locating items which satisfy a general requirement and then ranking those items according to the utility specified for each type of item by a user. Preferably, the present invention is implemented utilizing an intelligent agent, although other software services or code may be utilized.

A general requirement is first received by the intelligent agent. The general requirement may be very broad including many different types of categories of items. For example, the requirement may be for a means of transportation which would include the categories of bicycles, cars, airplanes, helicopters, and other types of transportation.

A utility is then specified for each type of item which would satisfy the general requirement. Typically, the utility will be specified by a user who has the general requirement.

The intelligent agent then searches for items which are available which would satisfy the requirement. Available items are located by the intelligent agent. The

intelligent agent compares the price for each located available item to the utility for that type of item and then ranks the located available items according to this comparison.

In one embodiment, the intelligent agent determines a utility to price ratio for each located item. The ratio is determined utilizing the price of an available item and the utility specified for that type of item. The intelligent agent then ranks the located items according to the ratio determined for each available item.

Once the available items are ranked, they may be displayed to a user who then may select one of the items. Alternatively, the intelligent agent may be empowered to automatically complete a purchase of the one item which is ranked as having the best utility to price comparison once that item is found.

With reference now to the figures, **Figure 1** depicts a pictorial representation of a network of data processing systems in which the present invention may be implemented. Network data processing system **100** is a network of computers in which the present invention may be implemented. Network data processing system **100** contains a network **102**, which is the medium used to provide communications links between various devices and computers connected together within network data processing system **100**. Network **102** may include connections, such as wire, wireless communication links, or fiber optic cables.

In the depicted example, a server **104** is connected to network **102** along with storage unit **106**. In addition, clients **108**, **110**, and **112** also are connected to network **102**. Network **102** may include permanent connections, such as wire or fiber optic cables, or temporary connections made through telephone connections. The communications network **102** also can include other public and/or private wide area networks, local area networks, wireless networks, data communication networks or connections, intranets, routers, satellite links, microwave links, cellular or telephone networks, radio links, fiber optic transmission lines, ISDN lines, T1 lines, DSL, etc. In some embodiments, a user

device may be connected directly to a server **104** without departing from the scope of the present invention. Moreover, as used herein, communications include those enabled by wired or wireless technology.

Clients **108**, **110**, and **112** may be, for example, personal computers, portable computers, mobile or fixed user stations, workstations, network terminals or servers, cellular telephones, kiosks, dumb terminals, personal digital assistants, two-way pagers, smart phones, information appliances, or network computers. For purposes of this application, a network computer is any computer, coupled to a network, which receives a program or other application from another computer coupled to the network.

In the depicted example, server **104** provides data, such as boot files, operating system images, and applications to clients **108-112**. Clients **108**, **110**, and **112** are clients to server **104**. Network data processing system **100** may include additional servers, clients, and other devices not shown. In the depicted example, network data processing system **100** is the Internet with network **102** representing a worldwide collection of networks and gateways that use the TCP/IP suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers, consisting of thousands of commercial, government, educational and other computer systems that route data and messages. Of course, network data processing system **100** also may be implemented as a number of different types of networks, such as for example, an intranet, a local area network (LAN), or a wide area network (WAN). **Figure 1** is intended as an example, and not as an architectural limitation for the present invention.

Referring to **Figure 2**, a block diagram of a data processing system that may be implemented as a server, such as server **104** in **Figure 1**, is depicted in accordance with a preferred embodiment of the present invention. Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors **202** and **204**

connected to system bus **206**. Alternatively, a single processor system may be employed. Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local memory **209**. I/O bus bridge **210** is connected to system bus **206** and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated as depicted.

Peripheral component interconnect (PCI) bus bridge **214** connected to I/O bus **212** provides an interface to PCI local bus **216**. A number of modems may be connected to PCI bus **216**. Typical PCI bus implementations will support four PCI expansion slots or add-in connectors. Communications links to network computers **108-112** in **Figure 1** may be provided through modem **218** and network adapter **220** connected to PCI local bus **216** through add-in boards.

Additional PCI bus bridges **222** and **224** provide interfaces for additional PCI buses **226** and **228**, from which additional modems or network adapters may be supported. In this manner, data processing system **200** allows connections to multiple network computers. A memory-mapped graphics adapter **230** and hard disk **232** may also be connected to I/O bus **212** as depicted, either directly or indirectly.

Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

The data processing system depicted in **Figure 2** may be, for example, an IBM RISC/System 6000 system, a product of International Business Machines Corporation in Armonk, New York, running the Advanced Interactive Executive (AIX) operating system.

With reference now to **Figure 3**, a block diagram illustrating a data processing system is depicted in which the present invention may be implemented. Data processing

system **300** is an example of a client computer. Data processing system **300** employs a peripheral component interconnect (PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures such as Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used. Processor **302** and main memory **304** are connected to PCI local bus **306** through PCI bridge **308**. PCI bridge **308** also may include an integrated memory controller and cache memory for processor **302**. Additional connections to PCI local bus **306** may be made through direct component interconnection or through add-in boards. In the depicted example, local area network (LAN) adapter **310**, SCSI host bus adapter **312**, and expansion bus interface **314** are connected to PCI local bus **306** by direct component connection. In contrast, audio adapter **316**, graphics adapter **318**, and audio/video adapter **319** are connected to PCI local bus **306** by add-in boards inserted into expansion slots. Expansion bus interface **314** provides a connection for a keyboard and mouse adapter **320**, modem **322**, and additional memory **324**. Small computer system interface (SCSI) host bus adapter **312** provides a connection for hard disk drive **326**, tape drive **328**, and CD-ROM drive **330**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **302** and is used to coordinate and provide control of various components within data processing system **300** in **Figure 3**. The operating system may be a commercially available operating system, such as Windows 2000, which is available from Microsoft Corporation. An object oriented programming system such as Java may run in conjunction with the operating system and provide calls to the operating system from Java programs or applications executing on data processing system **300**. "Java" is a trademark of Sun Microsystems, Inc. Instructions for the operating system, the object-oriented operating system, and applications or programs are located on storage devices, such as hard disk drive **326**, and may be loaded into main memory **304** for execution by processor **302.**

Those of ordinary skill in the art will appreciate that the hardware in **Figure 3** may vary depending on the implementation. Other internal hardware or peripheral devices, such as flash ROM (or equivalent nonvolatile memory) or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 3**. Also, the processes of the present invention may be applied to a multiprocessor data processing system.

As another example, data processing system **300** may be a stand-alone system configured to be bootable without relying on some type of network communication interface, whether or not data processing system **300** comprises some type of network communication interface. As a further example, data processing system **300** may be a Personal Digital Assistant (PDA) device, which is configured with ROM and/or flash ROM in order to provide non-volatile memory for storing operating system files and/or user-generated data.

The depicted example in **Figure 3** and above-described examples are not meant to imply architectural limitations. For example, data processing system **300** also may be a notebook computer or hand held computer in addition to taking the form of a PDA. Data processing system **300** also may be a kiosk or a Web appliance.

Figure 4 is a high level flow chart which depicts a specification of a utility for different types of items in accordance with the present invention. The process starts as depicted by block **400** and thereafter passes to block **402** which illustrates the specification of a general requirement. A user may specify a general requirement, for example, of some means of transportation. Next, block **404** depicts a specification of particular types of items which would satisfy the requirement. In this example, a bicycle, a motorcycle, or a car would satisfy this general requirement. Thereafter, block **406** illustrates a specification of a plurality of attributes for the items. Continuing with the transportation example, attributes such as color, body style, ease-of-use, difficulty of maintaining, price, and other attributes

may be specified. Thereafter, block **408** illustrates a specification of a weighting value for each attribute for each type of item which would satisfy the requirement. Ease-of-use may be valued more highly by some users over price. For other users, status may be valued more highly over price. Block **410**, then, depicts a calculation of an overall utility using the weighting values for each attribute for each type of item which would satisfy the requirement. The process then terminates as illustrated by block **412**.

The following is a simplified example of the present invention. Suppose three people are each interested in purchasing a car. Utility information is first elicited from each person as shown below.

	Person 1	Person 2	Person 3
Prestige	80	0	0
Reliability	20	180	20
Economy	0	20	80
TOTAL	100	200	100

Utility weighting values are then calculated for each person for each attribute as shown below by dividing the utility by the total. Any other suitable method for calculating weighting values may be utilized.

	Person 1	Person 2	Person 3
Prestige	0.8	0	0
Reliability	0.2	0.9	0.2
Economy	0	0.1	0.8

Further suppose that three different cars have been assigned the following ratings for the three attributes of interest to these potential buyers, prestige, reliability, and economy. Some of these rankings are very subjective and may be entered by each person. For example, each person could enter the prestige rankings. Other rankings, such as reliability may be more objective and could be obtained from some third party source. Still other rankings might be computed by the present invention. For example, a cost of

ownership could be calculated by the present invention if lifetime maintenance costs, fuel consumption, resale, and other information is provided.

	Car 1	Car 2	Car 3
Prestige	90	20	0
Reliability	80	99	70
Economy	20	40	99

The present invention then calculates a value for each person for each attribute by multiplying the weighting value for an attribute and the rating for that attribute. The following values are thus determined for Car 1.

	Person 1	Person 2	Person 3
Prestige	90 x 0.8 = 72	90 x 0 = 0	90 x 0 = 0
Reliability	80 x 0.2 = 16	80 x 0.9 = 72	80 x 0.2 = 16
Economy	20 x 0 = 0	20 x 0.1 = 2	20 x 0.8 = 16
TOTAL	88	74	32

Similar calculations are made for Car 2.

	Person 1	Person 2	Person 3
Prestige	16	0	0
Reliability	19.8	89.1	19.8
Economy	0	4	32
TOTAL	35.8	93.1	51.8

The following are the values for Car 3.

	Person 1	Person 2	Person 3
Prestige	0	0	0
Reliability	14	63	14
Economy	0	9.9	79.2
TOTAL	14	72.9	93.2

A utility matrix having the total utility for each person for each car is created by taking the numbers from the calculations completed above.

	Person 1	Person 2	Person 3
Car 1	88	74	32
Car 2	35.8	93.1	51.8
Car 3	14	72.9	93.2

The present invention then searches for available cars matching Car 1, Car 2, and Car 3 and locates those having the best price. Suppose the following available cars were found.

	Price
Car 1	$ 35, 000
Car 2	$ 20, 000
Car 3	$ 16, 000

A comparison is then made between each car and the total utility from the utility matrix. For the comparison calculation shown below, the price was divided by the total utility.

	Person 1	Person 2	Person 3
Car 1	397.73	472.97	1,093.75
Car 2	558.66	214.82	386.1
Car 3	1,142.86	219.48	171.67

The car which maximizes the utility for each person, in this case the car having the lowest number, is then selected. Therefore, Car 1 is selected for Person 1. Car 2 is selected for Person 2. And, Car 3 is selected for Person 3.

Figure 5 is a high level flow chart which depicts an intelligent software agent searching for and locating available items which match a specified type of items and ranking the located items according to the items' utility in accordance with the present invention. The process starts as depicted by block **500** and thereafter passes to block **502** which illustrates the launching of an intelligent software agent. Those skilled in the art will recognize that other software services, utilities, or code may be utilized instead of an

intelligent software agent to implement the present invention.

Next, block **504** depicts the intelligent agent searching for and locating individual items which are available to be purchased which match the specified types of items which would satisfy the requirement. The process then passes to block **506** which illustrates the intelligent agent retrieving information about one or more individual items which match the specified types of items. Thereafter, block **508** depicts the intelligent agent comparing the price for each located item to the utility specified for that type of item. Block **510**, then, illustrates the intelligent agent ranking each located item according to the comparison of the item's price to that type of item's utility. One method for comparing the price to utility is to calculate a ratio of the price to the utility. Another method for making such a comparison is to calculate the difference between the utility and the price. As yet another method to make a comparison, a user could specify a minimum utility. Thereafter, the lowest priced available item which meets or exceeds this minimum utility would be ranked as maximizing the user's utility. Any other method for making a comparison may be utilized. The process then passes to block **512** which depicts the intelligent agent displaying these located items in order of their ranking, preferably from the item having the best comparison to the item having the worst comparison.

Next, block **514** illustrates a determination of whether or not the intelligent agent is to complete the transaction by purchasing the item with the best comparison of price to utility, i.e. the individual item which maximizes utility. If a determination is made that the intelligent agent is not to complete the transaction by purchasing the item, the process passes to block **516** which depicts receiving a selection from a user of one of the items. Thereafter, block **518** illustrates processing the selection according to instructions received from a user. The process then terminates as depicted by block **520**.

Referring again to block **514**, if a determination is made that the intelligent agent is to complete the transaction by purchasing the item, the process passes to block **522** which depicts the intelligent agent using the information retrieved about the items which matched the specified types of items to select the located item which maximizes the comparison. Next, block **524** illustrates the intelligent agent completing a purchase transaction for the selected item. The process then terminates as depicted by block **520**.

The description of the form of the utility function described in the preferred embodiment of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. We have described a simple way to build a utility function that determines a degree of utility by aggregating multiple criteria into a single function. However utility functions can take many forms, and utility can be elicited in a number of ways. Forms include, for example, the linear additive, non-linear multiplicative, and multi-linear form. There are other approaches for specifying and eliciting utility known to those skilled in the art, such as the Analytic Heirarchy Process, which comprises hierarchically decompose the problem to make the multi-attribute utility analysis more tractable. This approach calls for breaking down the highest-level goal into sub-goals, which can then be further broken down into sub-goals, and then sub-sub-goals, until measurable utility criteria can be determined. Weights to the criteria can then be determined in a number of ways, including pair-wise comparisons along dimensions such as ordinality, cardinality, or ranking along a linguistic scale.

Other approaches besides the utility function approach can be used, such as the out-ranking approach, which involves determining a relation which contains the preferences of each alternative over all the other alternatives, and is thus somewhat richer than the utility function approach. Other approaches, such as the lexicographic approach,

use an ordered set of preference classes defined across attributes and their levels. Fuzzy logic approaches can be used as well, including use of fuzzy utility, fuzzy out-ranking, fuzzy inference, fuzzy control, or the fuzzy analytical hierarchical process. All these approaches for eliciting and modeling utility, and for performing multi-attribute utility analysis, and others known to those skilled in the art, are applicable to the present invention.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media such a floppy disc, a hard disk drive, a RAM, and CD-ROMs and transmission-type media such as digital and analog communications links.

The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.